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METHOD OF MANUFACTURE OF BLADES, (U)

JAN 78 S Z FIOLIN, V V BOYTISOV, A V BAKHAREV

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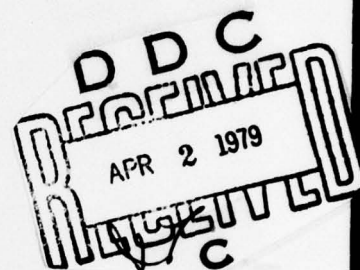
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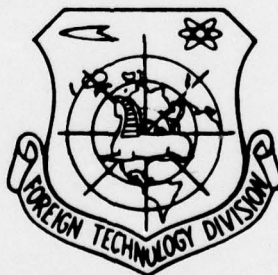
## FOREIGN TECHNOLOGY DIVISION



METHOD OF MANUFACTURE OF BLADES

by

S. Z. Figlin, V. V. Boytsov, et al.



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78 11 17 108

FTD-ID(RS)T-2337-77

## EDITED TRANSLATION

FTD-ID(RS)T-2337-77

12 January 1978

MICROFICHE NR: *FTD-78C-000103*

METHOD OF MANUFACTURE OF BLADES

By: S. Z. Figlin, V. V. Boytsov, et al.

English pages: 4

Source: USSR patent No. 260382, 20 May 1970, pp. 1-2.

Country of origin: USSR

Translated by: Robert Allen Potts

Requester: ASD/FTD/ETID

Approved for public release;  
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# U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<b>А а</b>	A, a	Р р	<b>Р р</b>	R, r
Б б	<b>Б б</b>	B, b	С с	<b>С с</b>	S, s
В в	<b>В в</b>	V, v	Т т	<b>Т т</b>	T, t
Г г	<b>Г г</b>	G, g	У у	<b>У у</b>	U, u
Д д	<b>Д д</b>	D, d	Ф ф	<b>Ф ф</b>	F, f
Е е	<b>Е е</b>	Ye, ye; E, e*	Х х	<b>Х х</b>	Kh, kh
Ж ж	<b>Ж ж</b>	Zh, zh	Ц ц	<b>Ц ц</b>	Ts, ts
З з	<b>З з</b>	Z, z	Ч ч	<b>Ч ч</b>	Ch, ch
И и	<b>И и</b>	I, i	Ш ш	<b>Ш ш</b>	Sh, sh
Й й	<b>Й й</b>	Y, y	Щ щ	<b>Щ щ</b>	Shch, shch
К к	<b>К к</b>	K, k	Ъ ъ	<b>Ъ ъ</b>	"
Л л	<b>Л л</b>	L, l	Ы ы	<b>Ы ы</b>	Y, y
М м	<b>М м</b>	M, m	Ь ь	<b>Ь ь</b>	'
Н н	<b>Н н</b>	N, n	Э э	<b>Э э</b>	E, e
О о	<b>О о</b>	O, o	Ю ю	<b>Ю ю</b>	Yu, yu
П п	<b>П п</b>	P, p	Я я	<b>Я я</b>	Ya, ya

\*ye initially, after vowels, and after Ъ, Ь; e elsewhere.  
When written as ё in Russian, transliterate as yë or ë.

## RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh <sup>-1</sup>
cos	cos	ch	cosh	arc ch	cosh <sup>-1</sup>
tg	tan	th	tanh	arc th	tanh <sup>-1</sup>
ctg	cot	cth	coth	arc cth	coth <sup>-1</sup>
sec	sec	sch	sech	arc sch	sech <sup>-1</sup>
cosec	csc	csch	csch	arc csch	csch <sup>-1</sup>
		Russian	English		
		rot	curl		
		lg	log		



2337

## METHOD OF MANUFACTURE OF BLADES

Authors of Invention: S. Z. Figlin, V. V. Boytsov, A. V. Bakharev, Yu. I. Kaplin, S. A. Kas'yanov, Yu. Ye. Rybkin, A. S. Nikishov, V. M. Arzhakov, O. A. Nikishov, L. G. Vertyukova, and L. P. Rink.

The invention pertains to the field of shaping metals by pressure, and namely to the manufacture of turbine and compressor blades from titanium and its alloys by stamping.

There is known a method of manufacture of blades from titanium and its alloys, with which the initial blank is covered with lubricant, heated to the stamping temperature and formed in a die, heated to the same temperature. However, with such a method during stamping there appear considerable nonuniformity of deformation and considerable elastic strains in the machine and the tool, which leads

to distortion of the geometry of the blades and, as a consequence, requires special operations of calibration and heat treatment, as a result of which substantial warping of the blades occurs.

The proposed method is distinguished by the fact that as lubricant we use enamel. With this the heating temperature of the blank is selected equal to the maximum annealing temperature of the material being shaped, and deformation is accomplished with the rate of deformation not exceeding 20 mm/s.

This raises the quality of the articles and reduces the technological cycle.

The proposed method involves the following.

The initial blank is preliminarily covered with a layer of enamel or glass lubricant, then the blank is heated to a temperature insignificantly (30-50°C) exceeding the lower limit of the temperature range of stamping, and is stamped with rate of deformation not exceeding 20 mm/s in a die with heat-insulation working zone. The die is heated to the stamping temperature.

The proposed method considerably lowers the force of deforming due to the absence of partial cooling of surface layers and deeper

occurrence of softening processes in the course of deformation itself. As a result of uniformity of the temperature field of the blank in the process of deformation the homogeneity of the structure is sharply raised. There is no longer a need to compensate for losses of heat of the heated blank by raising the initial temperature of heating in the furnace. In the proposed method the temperature of heating of the blank of alloy VTZ-1 is 870-20°C. Lowering of the initial heating temperature of the blank in conjunction with preliminary covering of the blank with enamel considerably reduces the degree of interaction of the heated metal with the surrounding medium, i.e., scale of the alpha-deposited layer (saturation by hydrogen, oxygen, nitrogen etc.) is formed.

In the proposed method the first high-temperature stage of heat treatment is combined with the last deformation-sizing, which, besides economy of expenditure for heat treatment, practically eliminates the warping of blades.

#### OBJECT OF INVENTION

The method of manufacture of blades from titanium and its alloys, with which the initial blank is covered with lubricant, is heated to the stamping temperature and shaped in the die, heated to



the same temperature, is distinguished by the fact that for raising the quality of articles and shortening the technological cycle, as lubricant we use enamel, with this the heating temperature of the blank is selected equal to the maximum annealing temperature of the material to be deformed, and deformation is accomplished at a rate of deformation not exceeding 20 mm/s.



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C535 AVIATION SYS COMD	1	ETID	3
		NIA/PHS	1
C591 FSTC	5	NICD	5
C619 MIA REDSTONE	1		
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